



Original research article

Oral care in patients with airway management: a prospective interventional study

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Abstract

Purpose: The study aims to analyse the current nursing practice of oral care in patients with invasive airway management in intensive care units (ICU).

Methods: A prospective three-phase interventional study was conducted for five months (10/2024 to 01/2025) in the acute ICU of a regional hospital in the Czech Republic. The first phase was observation and evaluation of oral care quality (nine-criterion audit tool, including an 11-item knowledge questionnaire for healthcare professionals). The second phase included familiarisation with best-practice recommendations and an increase in knowledge (professional education, informational materials). The third phase assessed the impact of the educational intervention on the oral care and healthcare professionals' knowledge.

Results: In the first phase of the study, overall success rate of correct responses to the questionnaire was only 53.91%. In the post-intervention third phase, overall success rate of correct responses to the questionnaire was 80.73%. When comparing the results of the second phase (observation and audit) of the established criteria before and after the educational intervention, care improved in all the monitored areas (knowledge of oral care, use of personal protective equipment (PPE), patient position, pre-intervention assessment and oral cavity suction, dental care and post intervention mouth rinse, care of the tongue, palate, mucous membranes, and lip care).

Conclusion: The interventional study identified gaps in knowledge about oral care for ICU patients. Education interventions led to the improvement of the quality of oral care in ICU patients with invasive airway management across all assessed criteria.

Keywords: Healthcare professionals; Intensive care unit; Invasive airway management; Oral care

Introduction

Patients requiring invasive airway management, such as endotracheal intubation or tracheostomy, face an increased risk of oral health deterioration and related complications, including ventilator-associated pneumonia (VAP), mucosal lesions, and systemic infections. The oropharyngeal cavity acts as a potential reservoir for pathogenic microorganisms, and in mechanically ventilated patients, insufficient oral care may influence bacterial colonization and aspiration into the lower respiratory tract (Yamakita et al., 2024; Yavuz et al., 2025).

Safe patient care depends on effective and efficient oral care. Oral care in the ICU patient population should be protocolized, systematic, and incorporated into routine nursing responsibilities from the moment of airway management. It is recommended that oral assessments be conducted at least once per shift, using a standardized oral assessment tool to evaluate mucosal integrity, presence of secretions, dryness, and potential lesions. Based on the assessment, a tailored oral care procedure should be followed (Asadi and Jahanimoghadam, 2024; Mohammad et al., 2024; Unahalekhaka et al., 2025).

There is no established standard for oral hygiene care in patients with invasive airway management. Inconsistent recommendations include endotracheal tube (ETT) / tracheostomy tube (TST) obturator cuff pressure, chlorhexidine application, and oropharyngeal and subglottic suctioning (Mastrogrianni et al., 2023). Significant differences are also found in the use of toothbrushes and toothpaste. This variability points to the absence of uniform protocols and, consequently, a lack of adherence to them if available (Dos Santos et al., 2025).

Mechanical removal of dental plaque is essential. Toothbrushing with a soft-bristled toothbrush or a disposable suction toothbrush should be performed at least twice daily. For patients unable to tolerate toothbrushing or when contraindicated, foam swabs moistened with sterile water can be used; however, these should not replace brushing (Collins et al., 2021). All materials should be single-use and designed for medical oral hygiene, with suction capability if available to prevent aspiration. The conclusions of the meta-analysis by Sozkes and Sozkes (2023) suggest that using toothbrushes in conjunction with an antiseptic liquid such as chlorhexidine gluconate (CHG) may be a very beneficial method for reducing the risk of VAP in mechanically ventilated patients. CHG

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at 0.12% or 0.2% concentration may be used by institutional policy, particularly in the early stages of mechanical ventilation, as part of a care bundle aimed at reducing VAP. However, consideration must be given to the potential adverse effects of long-term or indiscriminate CHG use, such as mucosal irritation, altered taste, or microbial resistance (Singh et al., 2022). Therefore, CHG should be applied selectively, avoiding routine long-term use, especially in patients ventilated beyond the acute phase (De Cassai et al., 2024). It is good practice to have a routine protocol in place for changing the antiseptics used, which is important for maintaining hygiene and safety in healthcare settings.

Quality assurance measures should be in place to monitor compliance with oral care protocols and track outcomes such as VAP rates, patient comfort, and incidence of oral complications. Data from internal audits should inform ongoing improvements and reinforce the role of oral care as a key component of airway management in critical care settings (Collins et al., 2021). Studies indicate that educational interventions, interprofessional collaboration, and standardized care bundles can significantly improve compliance and patient outcomes (Lin et al., 2024; Yavuz et al., 2025). Yet, there is a paucity of prospective data examining the real-world implementation of these recommended practices, particularly in high-risk populations with invasive airway support. Barriers include a lack of knowledge, time constraints, and variability in institutional protocols (Li and Wang, 2024; SuWen et al., 2025).

Based on the above-mentioned gaps, we set up a prospective interventional study, which aimed to analyse the current knowledge level and practice of oral care in patients with invasive airway management at ICUs. We supported the implementation of proper nursing procedures, following the latest recommendations based on scientific literature.

Materials and methods

Study design

A prospective interventional study was carried out. The nursing practices and interventions were examined in an acute intensive care unit within a regional hospital in our state. This study was initiated by the ward management to standardise nursing practices and enhance the quality of clinical care.

Participants

All healthcare professionals (HCPs) meeting the inclusion criteria were included in the study.

Inclusion criteria:

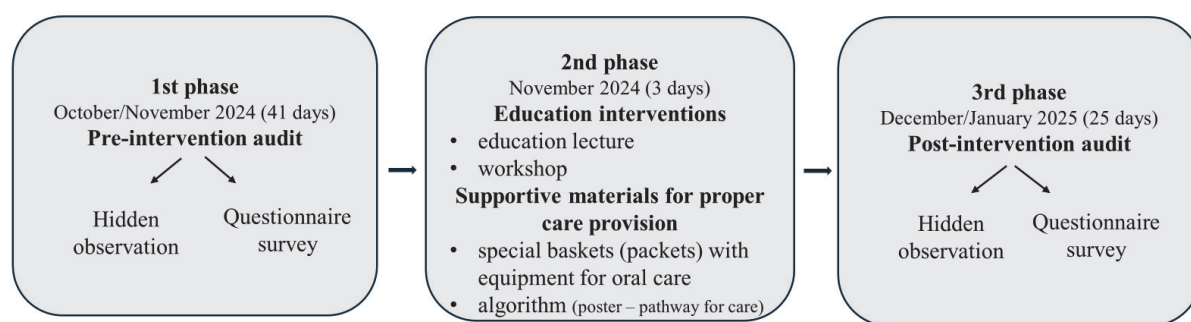
- HCPs had to be in permanent employment at the collaborating ICU.
- HCPs had competency in performing oral health care for ICU patients based on national legislation (general nurses, nurses with specialised intensive care education, paramedics).
- HCPs performed oral care in patients with airway management.
- HCPs consented to participation in all three phases of the study.

Exclusion criteria:

- HCPs performed oral care in patients with non-invasive respiratory care.
- HCPs performed oral care partially (mainly in patients partially self-sufficient in oral hygiene).

Intervention study phase and data collection tools

The intervention study was conducted in three phases from October 2024 to January 2025, see Scheme 1.



Scheme 1. Study phases

Phase 1: Pre-intervention audit

The first phase assessed the process of oral care in patients with invasive airway management. Data collection involved hidden observation based on predefined criteria (observer was an internal member of the healthcare team and also the research team), supplemented by a knowledge questionnaire related to the monitored topic. For practice evaluation, an audit checklist was developed (Table 1), designed by the research team. The observer was specially trained by a research team. Only one person conducted the observation; additional raters were not necessary. Both instruments were constructed based on evidence-based recommendations drawn from scientific literature.

Questionnaire survey

The self-constructed knowledge questionnaire consisted of 11 items in the form of statements, compiled based on scientific literature. An expert assessment approach was used to evaluate content validity. The questionnaire was submitted to three experts in the field of intensive care, who independently rated each item across three dimensions: relevance, comprehensibility, and completeness. The assessment was conducted using a four-point scale (1 = completely inappropriate, 4 = completely appropriate).

Based on these ratings, the Item Content Validity Index (I-CVI) was calculated, representing the proportion of experts who rated a given item as either 3 or 4. All items achieved an

Table 1. Criteria for the evaluation of oral care in patients with invasive airway management (questionnaire and observation during the audit)

Criteria	Data collection methods
1. HCPs have sufficient knowledge of oral care for patients with invasive airway management.	Evaluation of knowledge questionnaire scores.
2. HCPs use appropriate personal protective equipment (PPE) when caring for the oral cavity.	Hidden participant observation – use of all PPE: non-sterile gloves, mouthpiece/respirator, disposable apron.
3. The patient is in the correct position for oral care.	Hidden participant observation – placing the patient in Fowler's position, unless this position is contraindicated.
4. Before starting oral care, the oral cavity is first assessed.	Hidden participant observation – inspection of the oral cavity using a mouth spatula and a flashlight.
5. Before dental care, secretions from the oral cavity are suctioned.	Hidden participant observation – suctioning secretions from the oral cavity before starting dental treatment.
6. Dental care is carried out according to the correct procedure using appropriate tools.	Hidden participant observation – a procedure using a soft disposable toothbrush/disposable toothbrush with a suction device and toothpaste twice a day.
7. After cleaning the teeth, they are rinsed, and excess water and dirt are suctioned out.	Hidden participant observation – rinsing teeth with sterile water, including suctioning from the oral cavity.
8. HCPs perform care of the tongue, palate, and mucous membranes.	Hidden participant observation – using antiseptics to chemically clean the oral cavity and moisturize the mucous membranes using foam oral swabs with sterile water, or using glycerine sticks.
9. HCPs perform lip care.	Hidden participant observation – applying lip balm or Vaseline.

I-CVI value of 1.00, indicating complete agreement among experts regarding suitability. Additionally, the Scale Content Validity Index based on the average method (S-CVI/Ave) was determined, also reaching the maximum value of 1.00. This confirms the instrument's suitability for use in the planned research.

The questionnaire was piloted with five respondents in another ICU, where the comprehensibility of the statements was verified. Based on the pilot results, the questionnaire was used in its original, unchanged form for the study.

Respondents answered “yes” (agreement with the statement), “no” (disagreement), or “I don't know”. The evaluation was based on an analysis of the number of correct and incorrect responses for each item. The “I don't know” response decreased the overall score and influenced the percentage of both right and wrong answers.

The knowledge score in individual areas was calculated as the sum of points for correct answers (correct answer = 1 point) and standardized to a range from 0 to 100 – representing the percentage of correct answers a respondent identified in a given area. A sufficient level of knowledge was defined as providing the right answers to at least 9 of the 11 items, corresponding to a success rate of 82%. This threshold was set for the requirements of professional practice in intensive care, where proper oral care practices are essential for preventing complications, particularly ventilator-associated pneumonia (Table 2).

Both the pre-intervention test and post-intervention test were completed by the respondents during the investigator meetings with participants. They had no opportunity to verify the items using external sources or to complete the questionnaire collaboratively.

Table 2. Questionnaire with correct answers

Item – statement	Correct answer
1. Poor oral hygiene increases the risk of developing ventilator-associated pneumonia.	Yes
2. Before starting oral care for patients with invasive airway management, HCPs must wear at least these two PPEs: a mouthpiece and an apron.	No
3. The recommended patient position when performing oral care is the supine position.	No
4. Before initiating oral care for patients with invasive airway management, HCPs will perform an oral cavity assessment using a flashlight and oral spatula at least twice daily.	Yes
5. It is not necessary to suction secretions from the oral cavity before starting oral care.	No
6. If a patient with invasive airway management has their teeth, it is necessary to mechanically clean their teeth using a soft toothbrush at least twice a day.	Yes
7. Fluoride toothpaste can be used to clean teeth in patients undergoing invasive airway treatment.	Yes
8. Regular tap water can be used to rinse teeth in patients with invasive airway management.	No
9. The entire oral cavity of patients with invasive airway management should be maintained with an antiseptic solution to prevent ventilator-associated pneumonia.	Yes
10. It is recommended to moisturize the oral mucosa at least every 2–4 hours, according to the patient's individual needs.	Yes
11. After mechanical teeth cleaning, it is necessary to use an antiseptic solution immediately.	No

Phase 2: Education interventions

In the second phase, barriers were identified. Based on these, a strategy for implementing changes in practice was developed, which processed recommended procedures for oral care in patients with invasive airway management.

The educational strategy for implementation followed the recommendations of the guideline for reporting evidence-based practice educational interventions and teaching (GREET – checklist) (Phillips et al., 2016) and was based on face-to-face teaching methodologies. The education included a lecture and a workshop that took place in the cooperating ICU, the addition of suitable tools, and the creation of a clear algorithm for individual steps in oral care. The lecture, supplemented by a PowerPoint presentation, contained the recommended procedure for oral care in patients on artificial pulmonary ventilation (invasive airway management), supplemented with illustrative images. Suitably recommended tools were introduced during the workshop. To improve clinical practice in oral care for patients with invasive airway management, supportive materials were developed, including special baskets (packets) with oral care equipment and an algorithm (poster – pathway for care).

Phase 3: Post-intervention audit

In the third phase, a reassessment of the practice was carried out to determine whether the changes had been implemented. The practice assessment was conducted one month after the education using a follow-up audit. This contained the same items and was carried out as the first audit, including a subsequent verification of the level of knowledge using a knowledge questionnaire.

Ethical aspects

The study was conducted according to the Declaration of Helsinki. Consent for the research was obtained from the hospital management (no special IRB number was given for the approval). The anonymity of all collected and obtained data were secured as the data were handled by professionals from the healthcare facility where the study took place, who were also part of the research team.

Results

The pre-intervention phase included 42 HCPs who met the inclusion criteria. Of these, 37 (88%) were women and 5 (12%) were men. The respondents had a mean age of 34.5 years, with the youngest being 23 and the oldest 44. The average length of professional experience in the ICU was 11.6 years. The post-intervention phase included 35 HCPs; 7 HCPs were not present in the ICU during the post-monitoring period.

Pre-intervention audit results

The best results in correct practice were achieved in criteria 8 and 9. In 90.48% of cases, HCPs appropriately cared for the tongue, palate, and oral mucosa. Antiseptic solutions and moisturizers for the oral cavity were used at regular intervals. Lip care involves the application of lip balm or Vaseline. In cases where a lesion on the lips was present, for example, due to the presence of an endotracheal tube, targeted treatment of the area was provided using available resources in the ICU. Criterion 3 also achieved satisfactory results, with 88.10% of patients positioned correctly during oral care. The remaining observed criteria were rated as insufficient (Table 3).

Table 3. Pre-intervention audit

Criteria	N = 42		%	
	Correctly	Incorrectly	Correctly	Incorrectly
1. HCPs use appropriate PPE when caring for the oral cavity.	13	29	30.95	69.05
2. The patient is in the correct position for oral care.	37	5	88.10	11.90
3. Before starting oral care, the oral cavity is first assessed.	5	37	11.90	88.10
4. Before dental care, secretions from the oral cavity are suctioned.	15	27	35.71	64.29
5. Dental care is carried out according to the correct procedure using appropriate tools.	14	28	33.33	66.67
6. After cleaning the teeth, the teeth are rinsed, and excess water and dirt are suctioned out.	10	32	23.81	76.19
7. HCPs perform care of the tongue, palate, and mucous membranes.	38	4	90.48	9.52
8. HCPs perform lip care.	38	4	90.48	9.52

Before the education, the overall success rate of correct responses to the questionnaire was just 53.91%. Only two HCPs achieved the required level of knowledge, reaching the threshold of 82% or more correct answers necessary to demonstrate a sufficient understanding of the subject matter. A total of 37 healthcare professionals (94.87%) did not reach the established score, and their knowledge of the subject matter was assessed as insufficient. Chart 1 presents the percentage of correct responses for each item.

Based on the results of the pre-intervention audit (complemented by the knowledge questionnaire outcomes), the key barriers to the implementation of best practices were identified:

- Insufficient knowledge among HCPs regarding oral care for patients with invasive airway management.
- Limited availability of aid supplies to provide specialized oral care for patients with invasive airway management.
- Low motivation among HCPs to perform all aspects of the recommended oral care procedures for patients with invasive airway management.
- Lack of a standardized protocol for oral care in intensive care unit patients.

The strategy to address the identified gaps includes motivating and educating HCPs through lectures and workshops, providing appropriate aids and supplies, and introducing an

algorithm outlining the recommended procedure (for more details, see the methodology section).

Post-intervention audit results

Post-intervention audit results demonstrate improvements in oral care with requirements across all criteria (Table 4).

The overall success rate of correct responses to the questionnaire in the post-intervention phase was 80.73%. A total of 19 (61.29%) HCPs achieved the required level of knowledge, and 12 (38.71%) HCPs did not reach the established score of 82% correct answers. Chart 2 shows the difference in correct answers in the pre-test and post-test for each item.

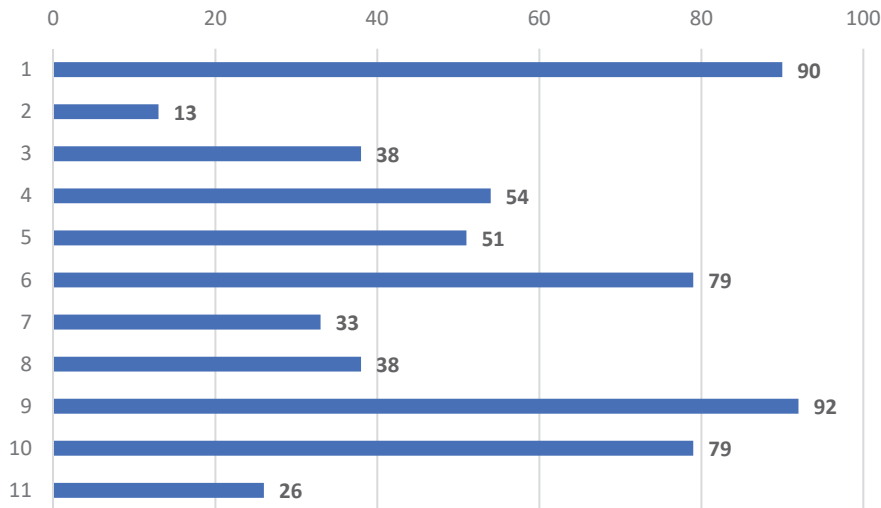


Chart 1. Pre-intervention test – correct answers

Table 4. Post-intervention audit

Criteria	N = 35		%	
	Correctly	Incorrectly	Correctly	Incorrectly
1. HCPs use appropriate PPE when caring for the oral cavity.	25	10	71.43	28.57
2. The patient is in the correct position for oral care.	31	4	88.57	11.43
3. Before starting oral care, the oral cavity is first assessed.	12	23	34.29	65.71
4. Before dental care, secretions from the oral cavity are suctioned.	28	7	80.00	20.00
5. Dental care is carried out according to the correct procedure using appropriate tools.	18	17	51.43	48.57
6. After cleaning the teeth, the teeth are rinsed, and excess water and dirt are suctioned out.	19	16	54.29	45.71
7. HCPs perform care of the tongue, palate, and mucous membranes.	33	2	94.29	5.71
8. HCPs perform lip care.	33	2	94.29	5.71

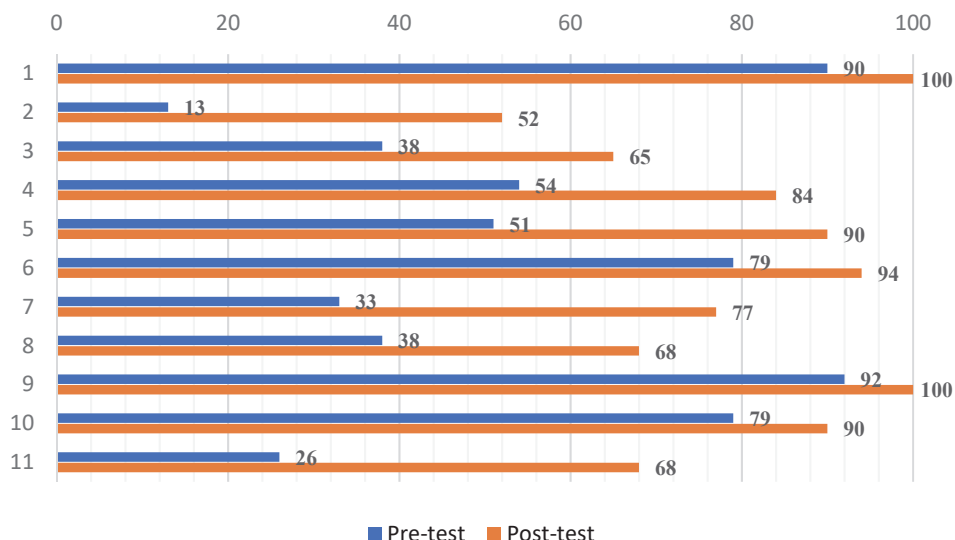


Chart 2. Pre-intervention test / Post-intervention test – correct answers %

When comparing the assessment of the established criteria before and after the implementation of the recom-

mended practices, care improved in all the monitored areas (Chart 3).

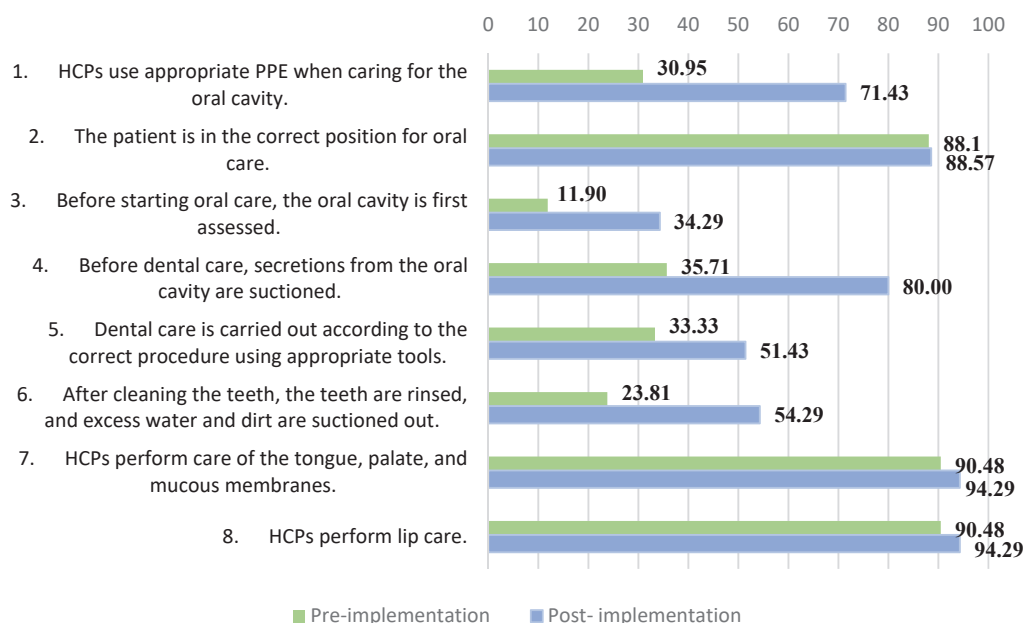


Chart 3. Pre-intervention audit / Post-intervention audit

Discussion

This intervention study assessed nursing practices and HCPs' knowledge of oral care in patients with invasive airway management, before and after targeted education in the clinical setting. The results of the study's pre-intervention test showed deficiencies in HCPs' knowledge of oral care, with a mean questionnaire score of only 53.91% correct answers. Educational activities improved HCPs' understanding of the topic of oral care. The overall success rate of correct responses in the post-intervention phase was 80.73%. Multiple cross-sectional studies have consistently highlighted ICU nurses' recognition of oral care as a critical yet challenging component of patient care, while also revealing significant gaps between attitudes, knowledge, and applied practice. Kumar et al. (2024) reported substantial variation in nurses' knowledge, particularly regarding toothbrushing duration and denture hygiene. Asadi and Jahanimoghdam (2024) found that nurses exhibit moderate knowledge, positive attitudes, and commendable self-reported practices in caring for intubated patients; notably both knowledge and attitude were significantly enhanced by formal education and clinical experience. Similarly, Narbutaitė et al. (2023) observed that while an overwhelming majority (82%) of ICU nurses acknowledged the importance of oral hygiene and 91% expressed willingness to engage in further training, many still perceived it as unpleasant or technically difficult, predominantly relying on foam swabs and moisturizers. Yavuz et al. (2021, but still referenced in 2025 analyses) emphasized that specialty-certified nurses devoted more time and priority to oral care, demonstrating that certification correlates with enhanced commitment and execution of oral hygiene measures. These studies suggest that although ICU nurses universally value oral care, gaps in education, discomfort with procedure, and institutional support continue to impede optimal delivery, underscoring the need for structured

training programs and standardized protocols to bridge the attitude-action divide. The educational interventions in our implementation study, in the form of lectures and workshops, had an impact on increasing the level of knowledge in oral care nursing practices in all the monitored criteria. Li et al. (2024) examined the trend of adherence to oral care protocols after short-term repeated educational interventions and compared the effect of micro-courses and conventional education on compliance. Both methods of education led to improved compliance, with no significant difference in oral care adherence, but the micro-course showed a more pronounced effect in the early phase and a faster rate of improvement.

The study's first phase revealed considerable variability in oral care practices for patients with airway management, identifying deficiencies in specific steps of the nursing process and the use of inappropriate equipment, such as the omission of oral cavity assessment before oral care and the failure to use disposable toothbrushes. The variability of current oral care practices for this group of ICU patients has been confirmed by international studies (Li et al., 2024; Vucelić et al., 2024). Recent evidence indicates that swabs fail to effectively remove dental biofilm, reinforcing that toothbrush-based methods remain superior in managing oral hygiene in ICU settings (Fu et al., 2023; Santos Zambrano et al., 2024; Zhao et al., 2020).

To provide quality oral care and prevent complications such as VAP, evidence-based care protocols are being developed that emphasize routine examinations, mechanical plaque removal, and the use of antiseptic agents. However, despite clear recommendations, adherence to best practices remains inconsistent across clinical settings (Asadi and Jahanimoghdam, 2024; Dos Santos et al., 2025).

The introduction of disposable oral care kits and protocols provides a simple but highly effective solution for proper oral care and thus the prevention of complications such as VAP. By standardizing oral care practices, these interventions address inconsistencies in care delivery while supporting evi-

dence-based practices. Therefore, the development and implementation of a standardized procedure in collaboration with the intensive care unit team was part of our study. The study by Unahalekhaka et al. (2025) confirmed positive feedback from ICU nurses that the care kits provided were practical, enabling staff to perform oral care confidently and effectively. Another study confirmed an increase in oral care levels after the introduction of a care kit (Sabrah et al., 2024). The special baskets (packets) were also prepared and distributed as part of this study, significantly facilitating adherence to the established precautions during the post-intervention phase. Their structured and standardized equipment enabled staff to navigate the individual steps of the intervention more easily, thereby supporting consistency in care delivery. In the post-intervention phase, the bundles played a key role in maintaining the implemented procedures and in supporting their further development and evaluation. Their practical application helped to increase adherence to the recommended measures and to reduce the risk of critical steps being omitted, which could impact care outcomes.

The post-intervention audit showed that education of HCPs in oral care, availability of new aids, and standardization of the procedure have an impact on improved knowledge and higher uniformity in the interventions performed. The project team trained 100% of HCPs who had competency in performing oral health care for ICU patients. The biggest success of the implementation project was the development of a protocol for oral care of patients with invasive airway management.

Strengths and limitations of our study

The intervention study has several strengths. First, the prospective design and systematic data collection allowed us to monitor the impact of the intervention in real time, thus minimizing retrospective bias. Furthermore, all interventions (staff training, standardization of tools, and protocols) needed to be implemented by integrating them into the daily practice of the ICU, which strengthens the external validity of the results and provides transferability of our experience to other settings.

Several limitations should be noted. The study was conducted in only one intensive care unit in a particular regional hospital, although it is a setting with a high volume of patients with invasive ventilation (invasive airway management). This limits the generalizability of the findings, as local organizational conditions, staff quality, and resource availability may differ elsewhere. Furthermore, we did not implement any external or peer-validated oral health assessment tool that was not part of our implementation strategy. Therefore, the results may be influenced by the subjective assessment of the implementing nurses, although their prior instruction and standardization of the procedure were ensured.

Conclusion

The study and its partial interventions improved the quality of oral care in patients with invasive airway management across all assessed criteria. To ensure the sustainability of evidence-based practices, regular training of the entire HCPs, including newly admitted healthcare professionals, and ongoing review of updated recommendations (which continue to evolve) are essential. We recommend following the interventions summarized in the tables used for the audit to ensure a higher quality of nursing care, as they describe proper care.

Authors' contributions

SS: conceptualization, design, methodology, data management, formal analysis, interpretation, supervision, writing original draft, and editing. NV: investigation and data collection, data management, and writing the original draft. AP: interpretation, supervision, writing the original draft, and final approval.

Conflict of interest

The authors have no conflict of interest to declare.

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